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ABSTRACT

This report is the first of three volumes which summarize the results of a comprehensive evaluation of the National Science Foundation (NSF) Local Course Improvement (LOCI) program. Included are college teacher perceived needs of course improvement, profile of applicants for LOCI awards, appropriateness of program guidelines, and outcomes of LOCI projects. Results indicate that most college science teachers feel that the science content and methods are in need of revision at their institution. These perceived needs were highest among teachers at community colleges, lower at four-year colleges, and lowest at universities. Individuals submitting proposals do not fully represent the eligible college teacher population with universities and four-year colleges submitting a disproportionately larger number of proposals. Review of LOCI proposals by NSF panels is considered fair with proposals from all types of institutions having about a one in four chance of selection. Most proposals do not commit the project directors to an appropriate evaluation of project outcomes; this is an area for change in the proposal writing guidelines. The success rate of LOCI projects is not high with six out of ten projects not achieving their major goals. Reasons for this failure are presented. (GS)

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Evaluation of the National Science Foundation's Local Course Improvement Program

Volume I

Executive Summary

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Chapter 1

Introduction

This report presents a summary of results from a comprehensive evaluation of NSF's Local Course Improvement (LOCI) program. A second volume describes detailed quantitative results from this evaluation, and a third volume describes detailed findings from site visits to institutions that received LOCI awards.

NSF first made awards to colleges and universities for local course improvement in 1976 through its program on Restructuring the Undergraduate Learning Experience (RULE). The awards provided up to $25,000, and as much as two-thirds of the total cost of a project for revising a course or course sequence. After 1977 NSF continued to make awards through a specially designated program on local course improvement--LOCI. For the sake of simplicity, in this report we refer to all local course improvement awards made from 1976 on as LOCI awards.

In 1976 NSF received 169 proposals for local course improvement projects and made 66 awards. In 1977 the program received 750 proposals and funded 129 projects. In 1978 it received 453 proposals and funded 135 projects. The statistically average project supported by LOCI during these three years required about 16 months for completion, and required about $11,000 of local funding, in addition to $16,000 from NSF. The typical project was expected to affect approximately 1300 students during a five-year period. It was about as likely to involve an introductory course as it was to involve an upper-division course.

The evaluation of LOCI focused on questions defined by NSF in four major areas. These areas were:

1) Need for support for local course improvement--Do college teachers need outside help to keep up with currently important scientific and instructional developments?
2) Response to LOCI--Do applicants for awards represent the full range of institutions and scientific fields?
3) Program rationale--Are program guidelines and restrictions reasonable? What other alternatives are there?
4) Outcomes of LOCI program--To what extent do projects achieve their objectives?

To answer the questions posed by NSF, we collected data using several different methods with four different populations:

1) To draw conclusions about the need for local course improvement, for example, we sent a questionnaire on teaching needs to a representative sample from the total population of 160,000 teachers of undergraduate science and engineering.
2) To determine whether the existing LOCI program was responsive to perceived needs, we used NSF documents to construct a profile of the 1358 applicants for LOCI awards during 1976-78, and we compared this profile to a national profile of college science teachers.
3) To determine whether program guidelines were appropriate, we read, classified, and analyzed 330 proposals funded by NSF during these years.

4) To evaluate outcomes of LOCI projects, we analyzed questionnaire responses and final reports from project directors of 66 completed projects. We also made site visits to a representative sample of these project directors.

The four chapters that follow present results from these four populations.

Chapter 2

Needs and Resources

To determine whether college science teachers could keep up with currently important scientific and instructional developments without help, we sent questionnaires to a representative sample of college science teachers. A total of 1262 (or 50.1% of the teachers we contacted) returned questionnaires.

Degree of need

Many of these teachers reported strong needs to improve content, teaching methods, and effectiveness of science teaching at their institutions. Figure 1 shows that:

> approximately 24% said that courses in their departments strongly needed revision in content, and an additional 42% reported moderate needs for course revision;
>
> approximately 24% said that teaching methods strongly needed revision, and an additional 35% reported at least moderate needs.

These teachers gave approximately equal stress to the need for revising teaching methods and the need for updating content of science courses. Both tasks seemed important to them. But respondents said that some educational outcomes needed improvement more than others did. They reported that the greatest need was to increase student learning, but they also reported a strong need to increase student satisfaction in science courses. They gave somewhat lower priority to increasing enrollments and community service and decreasing course dropouts.

Effectiveness of support programs

These college teachers also thought that the sort of support that LOCI provides would lead to improvement of science courses. Figure 2 shows that:

> approximately 46% said that providing summer salary support for teaching improvement efforts would be a highly effective way of bringing about improved teaching, and an additional 38% said that providing summer salary would be moderately effective;
>
> approximately 42% said that providing released time during the academic year would be highly effective, and an additional 39% said that released time would be moderately effective.

These were the two items--providing summer salary and providing released time--that received the highest effectiveness ratings. Nearly half the respondents to the survey questionnaire rated these items as highly effective in improving science teaching. Small grants to support teaching effectiveness seemed almost as effective to respondents to the questionnaire. Ratings were more moderate for travel funds, paid assistants, and consultants on teaching improvement.

Availability of local support

Teachers in our survey said, however, that support of the sort LOCI provides was either unavailable or low in availability at their colleges and universities. The two items reported to be least available were those considered most effective by respondents: summer salary and released time. Figure 3 shows that:

> nearly two-thirds of all teachers said that summer salary was "not at all" available at their institutions for teaching improvement projects;
>
> nearly half of all respondents said that released time for such work was unavailable during the academic year.

Although other items (i.e., travel funds, small teaching grants, consultation, and paid assistants) were available to more respondents, even these items were not generally available to college science teachers.

Institutional differences

Perceptions of needs and resources were somewhat different at different institutions. Perceived needs were highest at community colleges, lower at four-year colleges, and lowest at universities. Resources of the type LOCI provides were perceived as most effective by teachers at community colleges and four-year colleges, and were seen as somewhat less effective by faculty members at universities. Availability of these resources was reported to be equally low, however, by teachers at all levels of institutions.

Differences among scientific fields

Perceived needs and resources were very similar in different areas of science. Teachers in hard and soft, pure and applied, life and nonlife sciences reported similar degrees of need and similar perceptions of resources in college science teaching. Individual characteristics of teachers also were unrelated to perceptions of needs and resources. Groups of respondents with different degrees, at different ranks, and with different undergraduate teaching responsibilities gave similar responses to our survey questions.

Conclusions about needs and resources

Our conclusion from this analysis is that the LOCI program is directed toward real needs that college teachers feel. Most college science teachers think that the content and methods of science courses

at their institutions need revision; most rate the kind of support that LOCI can provide as highly valuable; and most report that this support is not available locally. There appears therefore to be a large group of college teachers that this program can serve.

The needs appear to be widespread in higher education. They are felt by teachers in different fields, with different degrees, at different ranks, and with different undergraduate teaching responsibilities. Perceptions, however, were somewhat different at different types of institutions. Perceived needs were highest at community colleges, lower at four-year colleges, and lowest at universities.

FIG. 1 - NEEDS REPORTED BY SCIENCE TEACHERS

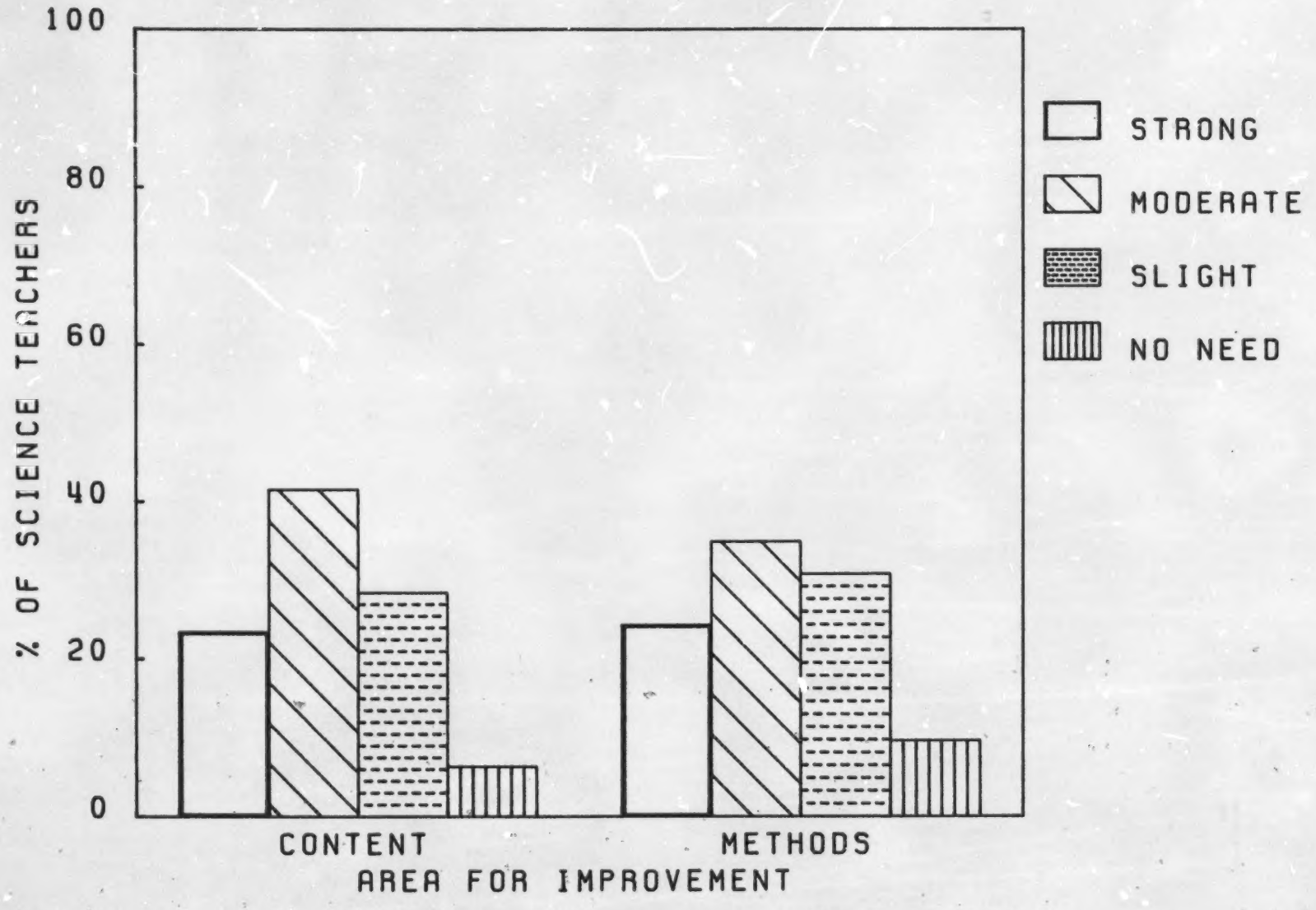


FIG. 2 - EFFECTIVENESS RATINGS FROM SCIENCE TEACHERS

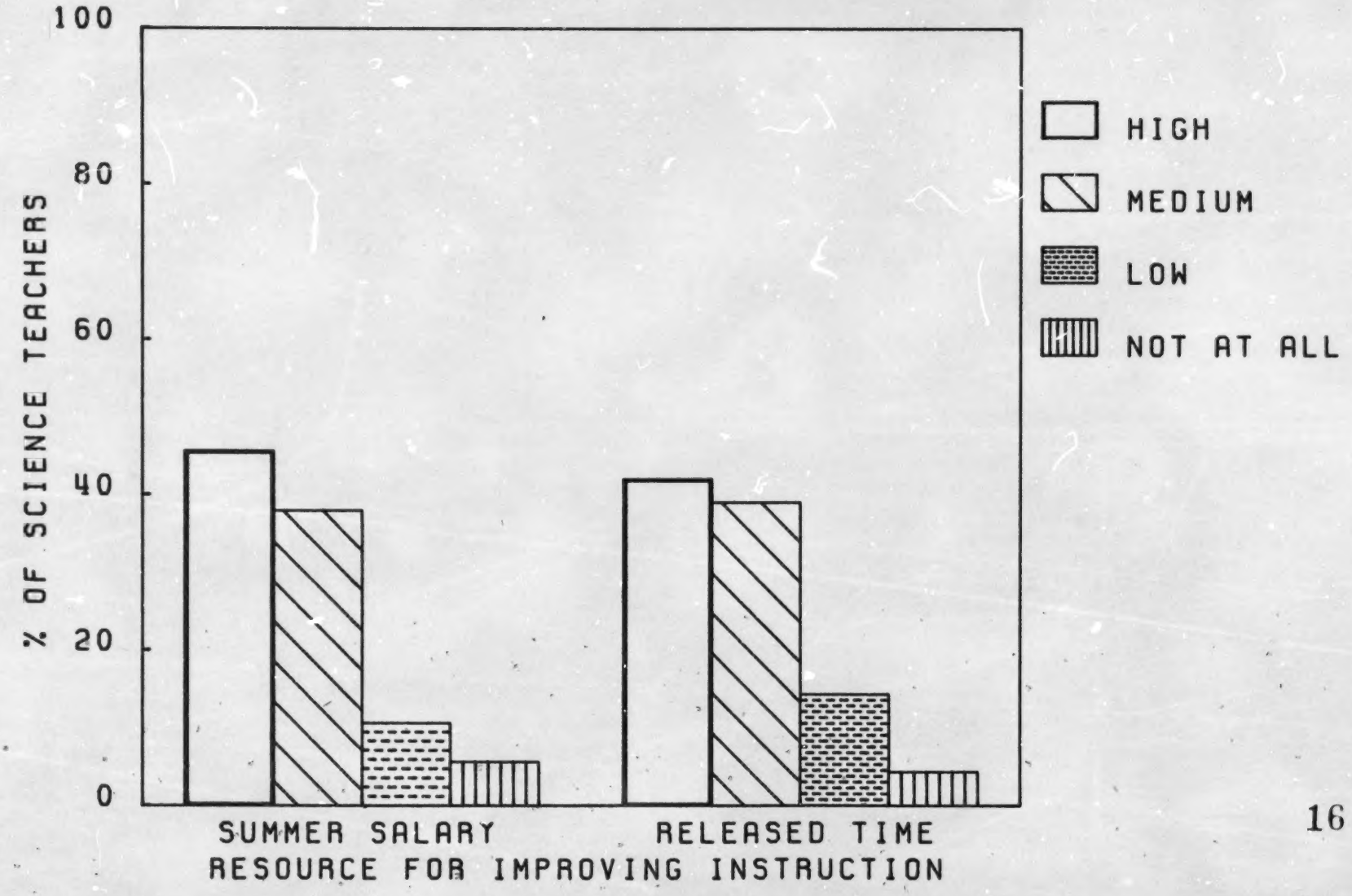
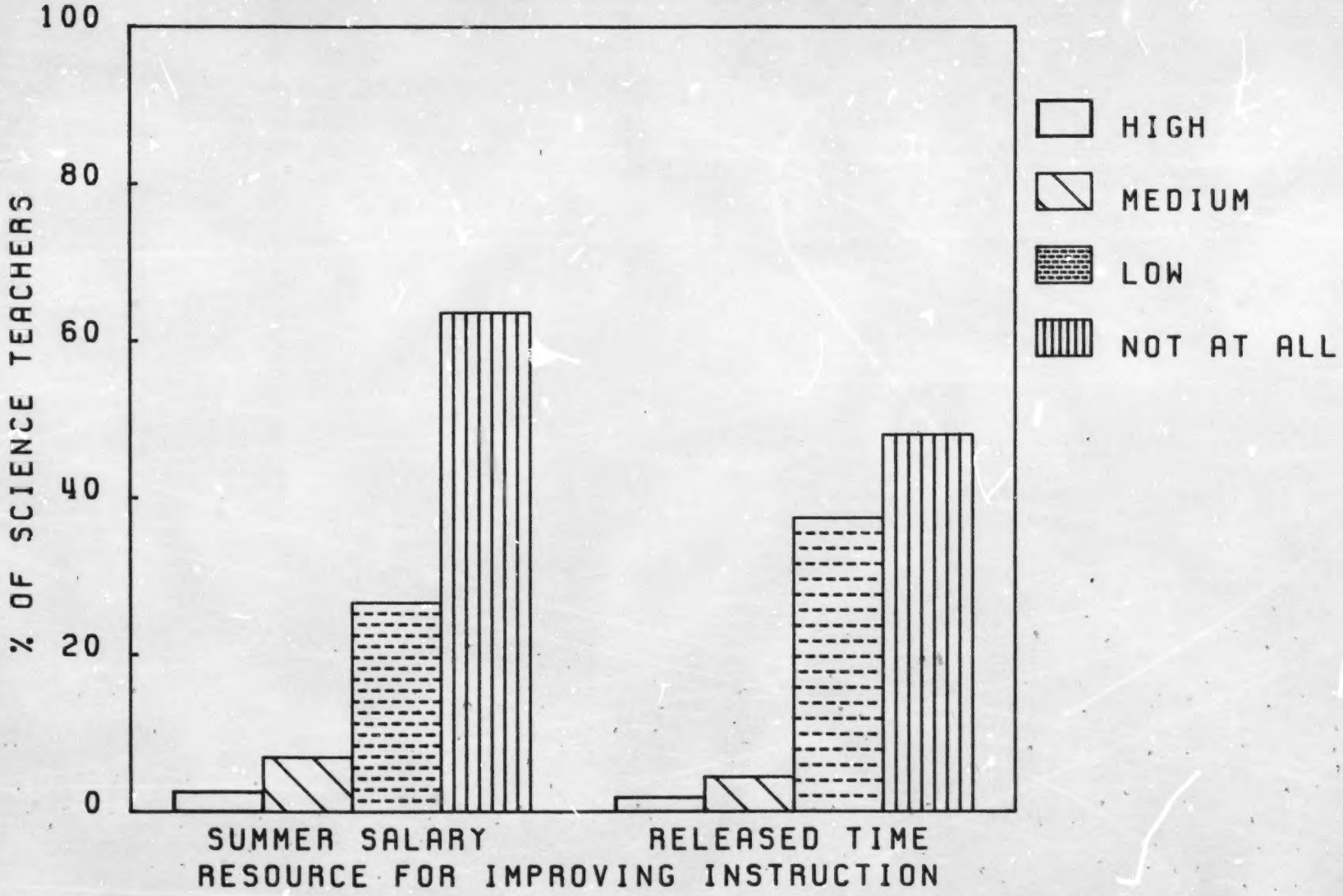


FIG. 3 - AVAILABILITY RATINGS FROM SCIENCE TEACHERS



Chapter 3

Response to LOCI

The second major area of concern in our evaluation was the response to LOCI. We found that individuals submitting proposals did not fully represent the population of eligible college science teachers:

> Universities and four-year colleges submitted more proposals than their undergraduate enrollments warranted; community colleges submitted far fewer than their share of proposals (Figure 4). In recent years, for example, more than one-third of all undergraduates were enrolled at community colleges. Yet only one-twelfth of all proposals came from this source.
>
> Private institutions also submitted more than their share of proposals (Figure 5). These institutions accounted for about one-fifth of all undergraduate enrollments recently, but well over one-third of all proposals came from private schools.
>
> The physical sciences, mathematics, computer sciences, and engineering submitted a disproportionate share of the proposals; the biological sciences, social sciences, and psychology submitted fewer proposals than expected (Figure 6).

Those institutions and fields submitting more than their share of proposals were not those with the greatest needs or fewest resources. A disproportionately large share of proposals instead seemed to come from those sectors of higher education with the strongest traditional links to NSF. These are the sectors of higher education that are especially concerned with education of professional scientists. A small share of the proposals, on the other hand, came from those sectors of higher education most concerned with science for non-specialists.

Our analyses suggested, however, that review of LOCI proposals by NSF review panels was evenhanded. Proposals from all types of institutions and scientific fields had about the same chance of

success--about one in four. Institutions and fields that submitted many proposals received many LOCI awards; institutions and fields that submitted few proposals received few awards.

Overall, therefore, the data suggested that LOCI awards do not go to a representative sample of eligible faculty members. In the first three years of the awards, about $500,000 rather than the expected $2,000,000 went to two-year colleges while $5,000,000 rather than the expected $3,500,000 went to universities and colleges. At the same time, $1,600,000 rather than the expected $3,200,000 went to the life sciences while $3,800,000 rather than the expected $2,100,000 went to the non-life sciences. Our data also suggested that these inequities cannot be rectified by improving review procedures at NSF. Review procedures now used appear to be fair and evenhanded. If NSF wants to change the present situation, its program managers will have to make special efforts to reach a more representative group of faculty members.

FIG. 4 - PROPOSALS SUBMITTED BY INSTITUTIONAL TYPE

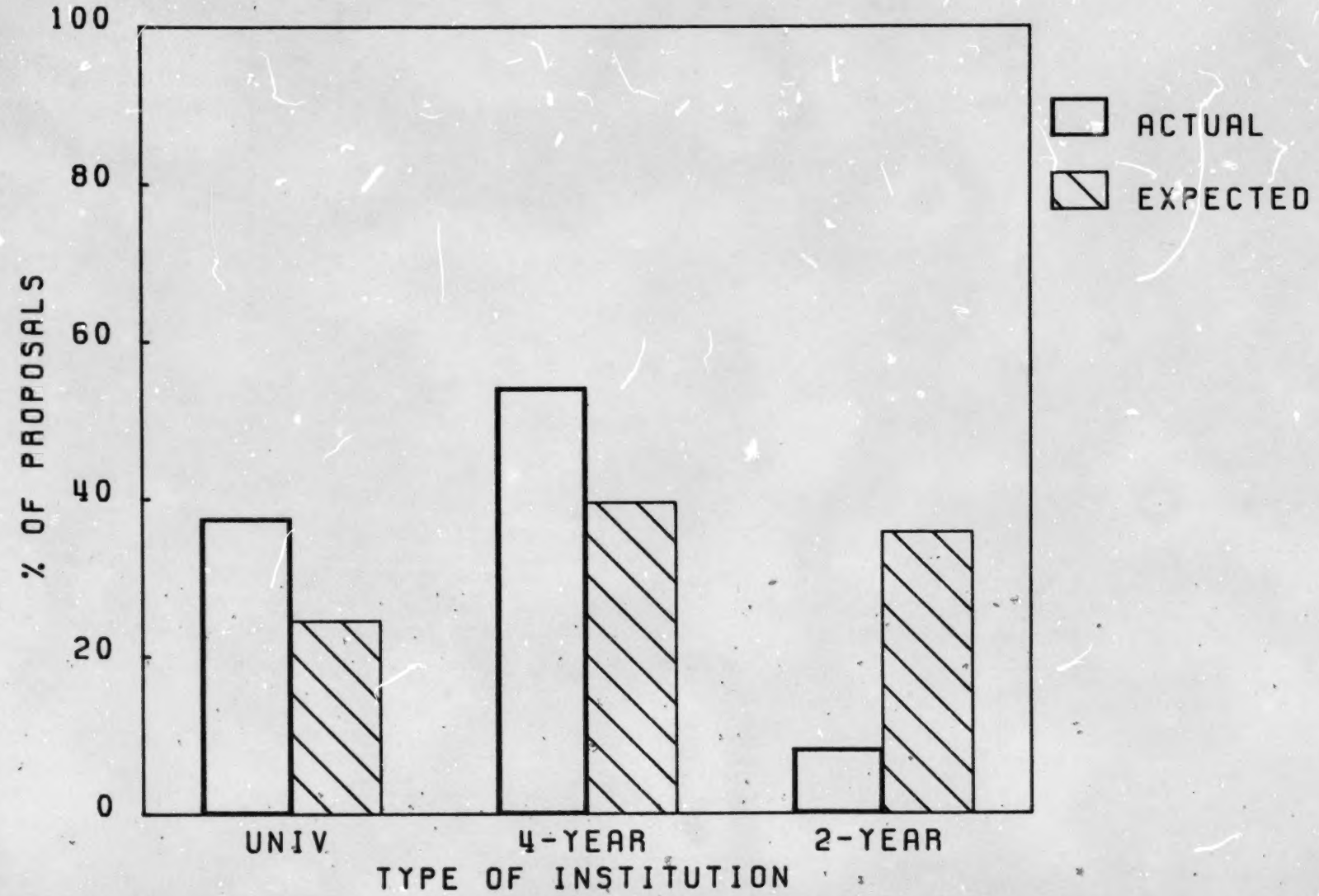


FIG. 5 - PROPOSALS SUBMITTED BY INSTITUTIONAL CONTROL

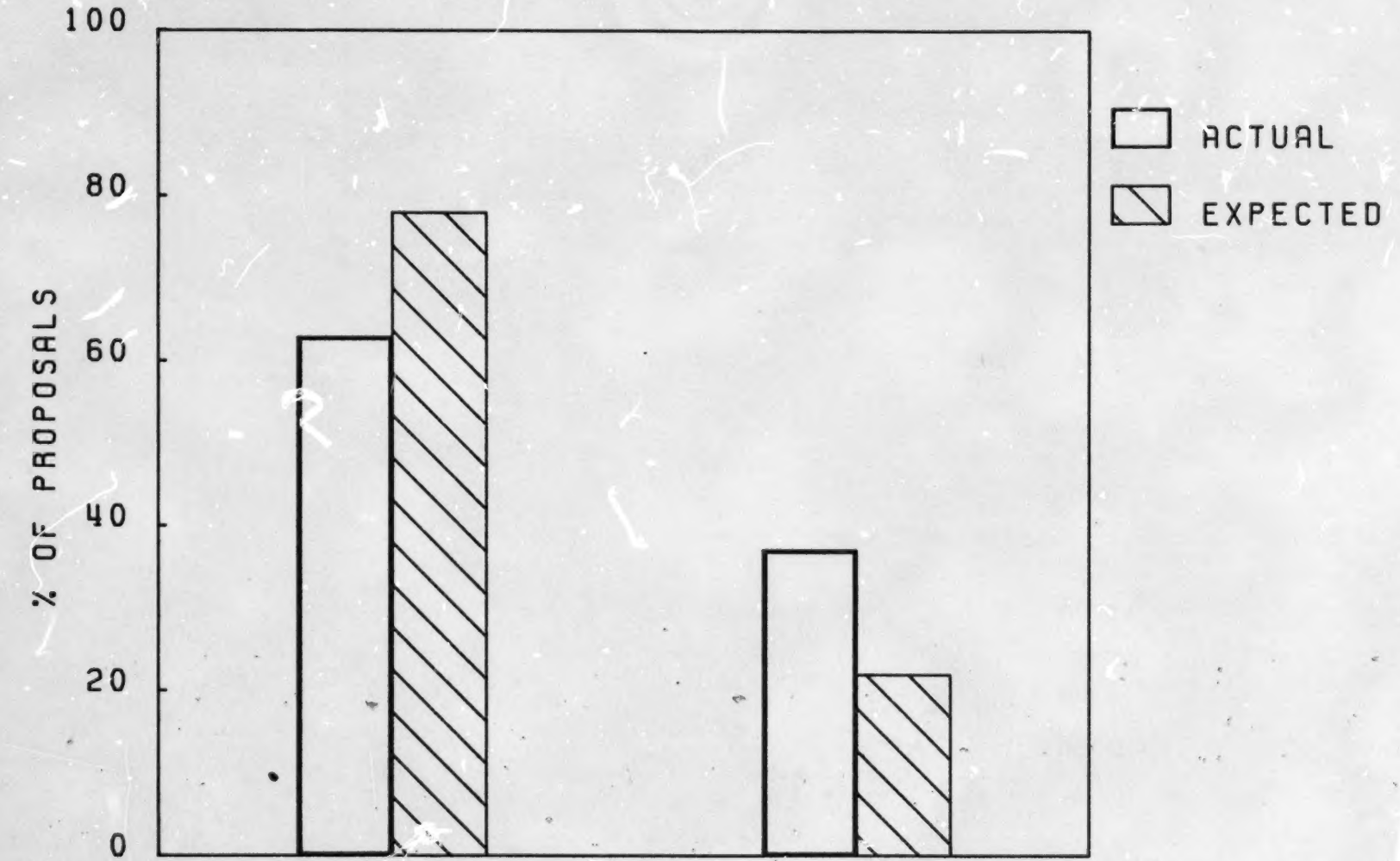
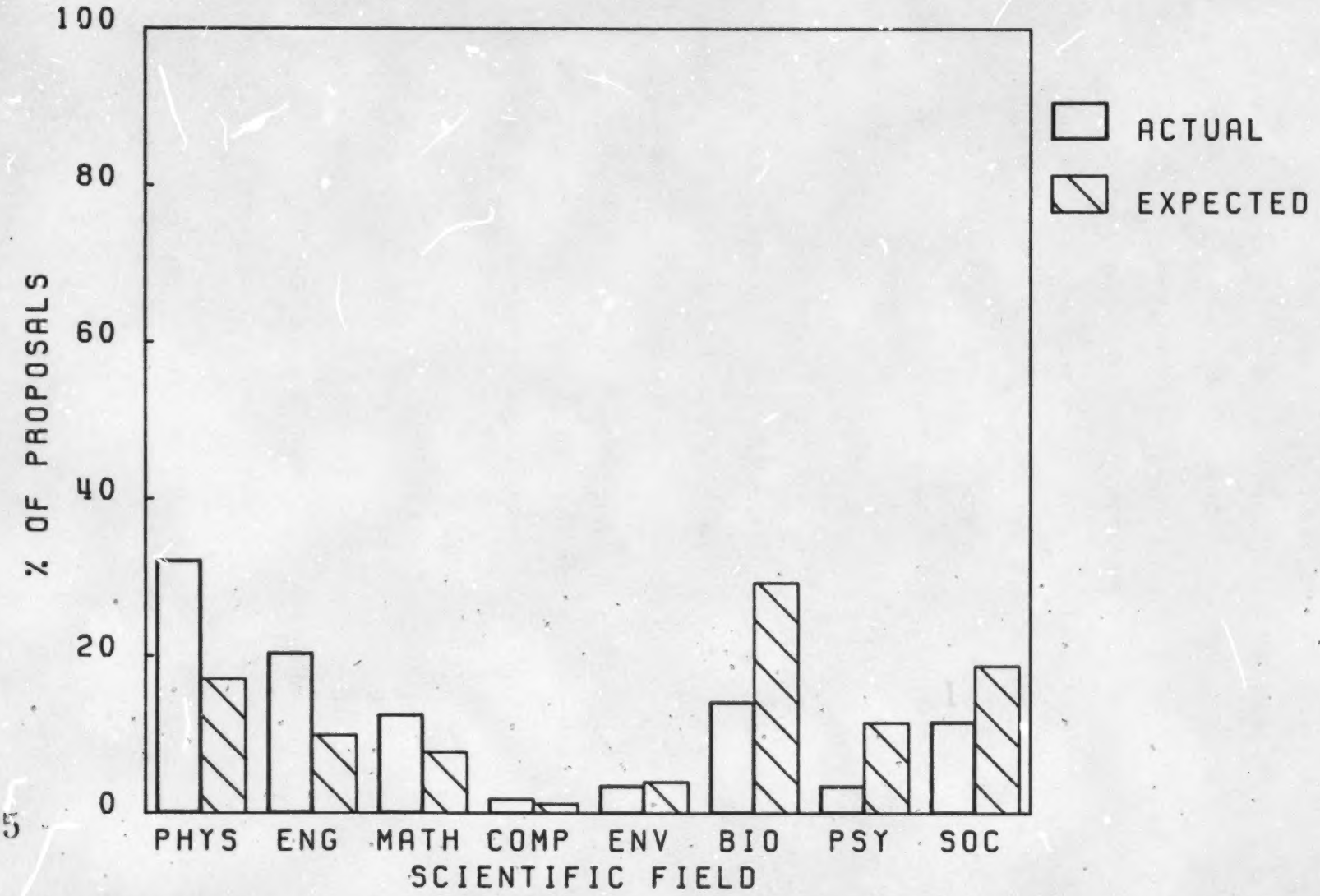


FIG. 6 - PROPOSALS SUBMITTED BY SCIENTIFIC FIELD



Chapter 4

LOCI Projects

Our next analyses focused on projects which received LOCI funding. Who were the project directors? What sorts of projects did they undertake with LOCI funding? What goals did project directors try to achieve in the projects? How did the project directors propose to evaluate the results of their work?

Project directors

LOCI project directors came from all academic ranks; they included instructors, assistant professors, associate professors, and full professors. Compared to national norms, however, professors were somewhat overrepresented and instructors and assistant professors somewhat underrepresented among recipients of awards (Figure 7). The appeal of LOCI to senior faculty members distinguishes it from other programs of support for instructional improvement.

Types of projects

Nearly 60% of all LOCI projects were directed toward revising teaching methodology, and about 40% toward updating or adding new content (Figure 8). About one-third of the methodology projects used the computer to individualize teaching, and many other projects sought to individualize instruction without the computer; e.g., with Keller's personalized system of instruction or Postlethwait's audiotutorial approach. Another large group of projects sought to improve teaching by use of inquiry learning; e.g., case materials, Wales' guided design approach, or open-ended laboratory investigations. Over two-thirds of

the content-oriented projects focused on a single course. The other content-oriented projects were directed toward a sequence of courses or were interdisciplinary projects.

Project goals

Project directors expected a variety of outcomes from their projects (Figure 9). Over three-quarters expected an increase in student knowledge and nearly three-quarters expected an increase in student satisfaction in courses revised with LOCI funding. Other outcomes mentioned by project directors were increased faculty satisfaction in teaching, greater cost effectiveness, and increased enrollment. Many of the project directors anticipated achieving success on more than one of these goals.

Proposed evaluation designs

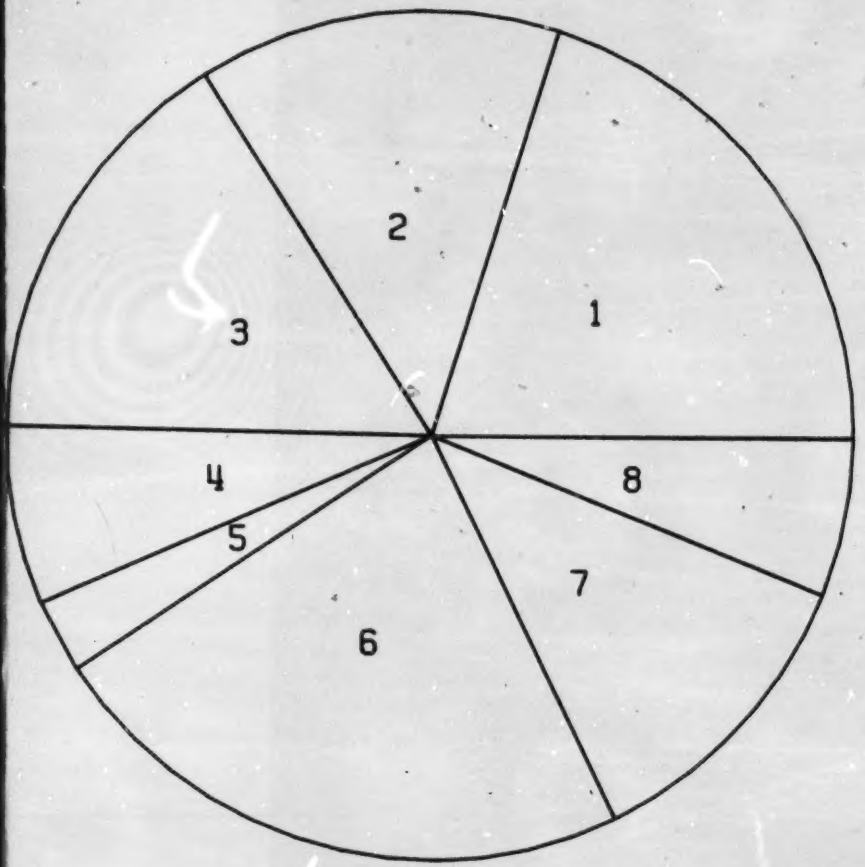
One of the most striking impressions left from our reading of 324 funded proposals was of the weakness in designs used to evaluate project outcomes. One-third of those who expected an increase in student achievement, for example, did not propose any formal measurement of student achievement in the course revised with LOCI funding. Another third proposed to measure student achievement in a revised course but did not plan to collect achievement data from a control course of any sort. Only one-third of those interested in student achievement intended to use both a treatment and control group in evaluating project outcomes.

Conclusions about LOCI projects

The most salient feature of the LOCI proposals that we read was the weakness of their evaluation designs. Most LOCI proposals did not commit the project directors to careful and controlled evaluation of project outcomes. Without well-planned evaluations, conclusions about results of projects will always be open to question. This is surely an area where better guidelines can be written for faculty members writing proposals and for reviewers reading them.

FIG. 7 - PROPOSALS SUBMITTED BY ACADEMIC RANK

FIG. 8 - TYPES OF LOCI PROJECTS



1 COMPUTER

2 INDIVIDUALIZED

3 INQUIRY

4 AV

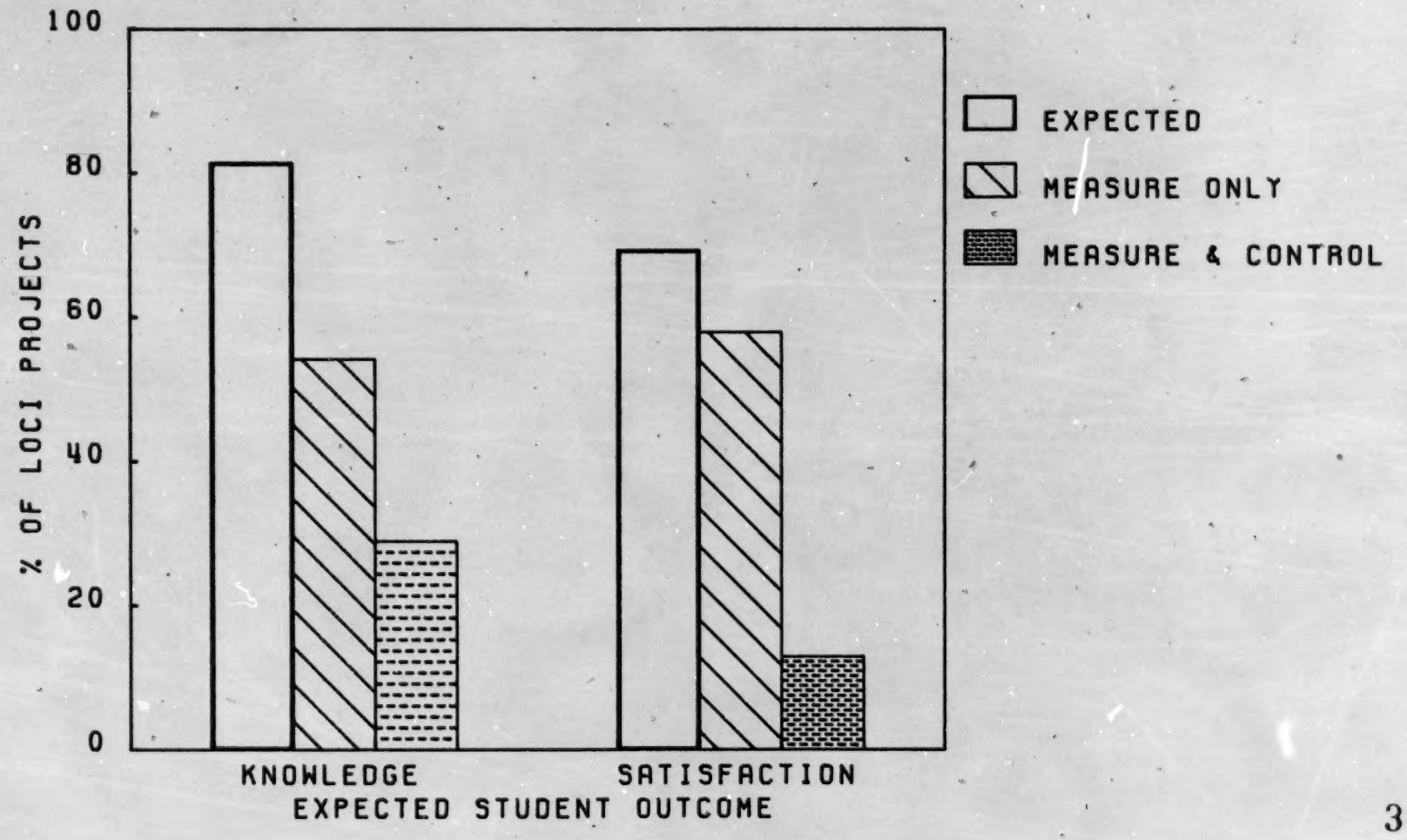
5 DISADVANTAGED

6 NEW COURSE

7 NEW PROGRAM

8 INTERDISC

FIG. 9 - EXPECTED OUTCOMES AND PROFOSED METHODS OF MEASUREMENT



Chapter 5

Outcomes

To determine whether LOCI projects achieved their objectives, we collected data from three different sources: a questionnaire survey of project directors, the final reports, and site visits. The different data sources gave different pictures of LOCI outcomes.

Questionnaires

Replies from the questionnaire showed that most project directors considered their projects to be very successful (Figure 10). The project directors reported clear benefits for their students from the projects (Figure 11). Most project directors also reported that the LOCI projects contributed to their professional development (Figure 12).

Final reports

LOCI project directors, however, did not document their results clearly in final reports to the NSF. Only 70% of the project directors had submitted reports of any kind within a year after the reports were due. Most of the reports that were submitted were brief and impressionistic. Not many reports were more than five pages in length, and quite a few were one page or less. About half of the reports lacked quantitative results, and about three-quarters lacked data from any sort of control or comparison group. Very few of the final reports demonstrated strong positive effects of LOCI projects on student achievement, satisfaction, instructional costs, or any other quantifiable instructional outcome.

Site visits

The site visits gave us an impression about project outcomes that was less positive than the impression conveyed by questionnaire results from LOCI project directors, but more positive than the impression left by final reports on LOCI projects. In our judgment, six out of ten projects achieved their major goals. One of the remaining four projects produced some positive effects, and three of the projects seemed to accomplish little of a positive nature. Three of the 10 project directors documented their project results with quantitative data in final reports. The other project directors submitted final reports that were descriptive or impressionistic or did not submit final reports at all.

We could not reach firm conclusions about factors that contributed to successful project outcomes because the sample of institutions that we visited was so small. The site visits, however, suggested that several factors may be related to successful project outcomes:

a) Projects involving "low" technology may have been more successful than projects involving more complex technologies. With more complex hardware, project directors seemed to run into more snags.

b) Projects that involved adaptation of existing instructional approaches seemed to have more positive outcomes than projects involving development of new approaches. Project directors who had clear models to imitate--especially models

that they had learned about in workshops--seemed to have an easier time than project directors who tried to construct new approaches by themselves.

c) Project directors with career commitments to instructional research and development seemed more likely to complete their projects successfully.

d) Projects directed by faculty members who had "settled in" at an institution seemed more successful than projects of faculty members in their first year at an institution.

e) Projects involving a single course taught by a LOCI project director seemed more successful than multi-course projects. Resources provided by LOCI may be spread too thin on multi-course projects.

Conclusions about outcomes

The success rate of these projects did not seem especially high to us, but we think that we were able to identify some factors that contributed to project failure. These factors included: emphasis on complex technology; emphasis on innovative rather than existing instructional approaches; and multi-course emphasis of the project. Factors that appeared to contribute to project success included: career commitment by the project director to instructional research and development, and several years of teaching experience of the project director at his or her institution.

More important than the apparent failure of some projects in our view was the failure of most LOCI project directors to document their project results clearly. In recent years educational researchers have developed tools for objectively synthesizing applied findings in

education and other areas, and these tools can yield objective generalizations about the overall effectiveness of large groups of projects and about the differential effectiveness of projects of different types, in different settings, and so on. In principle, these tools can be applied to results from funding programs such as LOCI, but in reality the results reported by LOCI project directors are far too impressionistic to be of use in objective synthesis. This seems to us to be a major shortcoming of the program.

FIG. 10 - OUTCOMES REPORTED BY PROJECT DIRECTORS

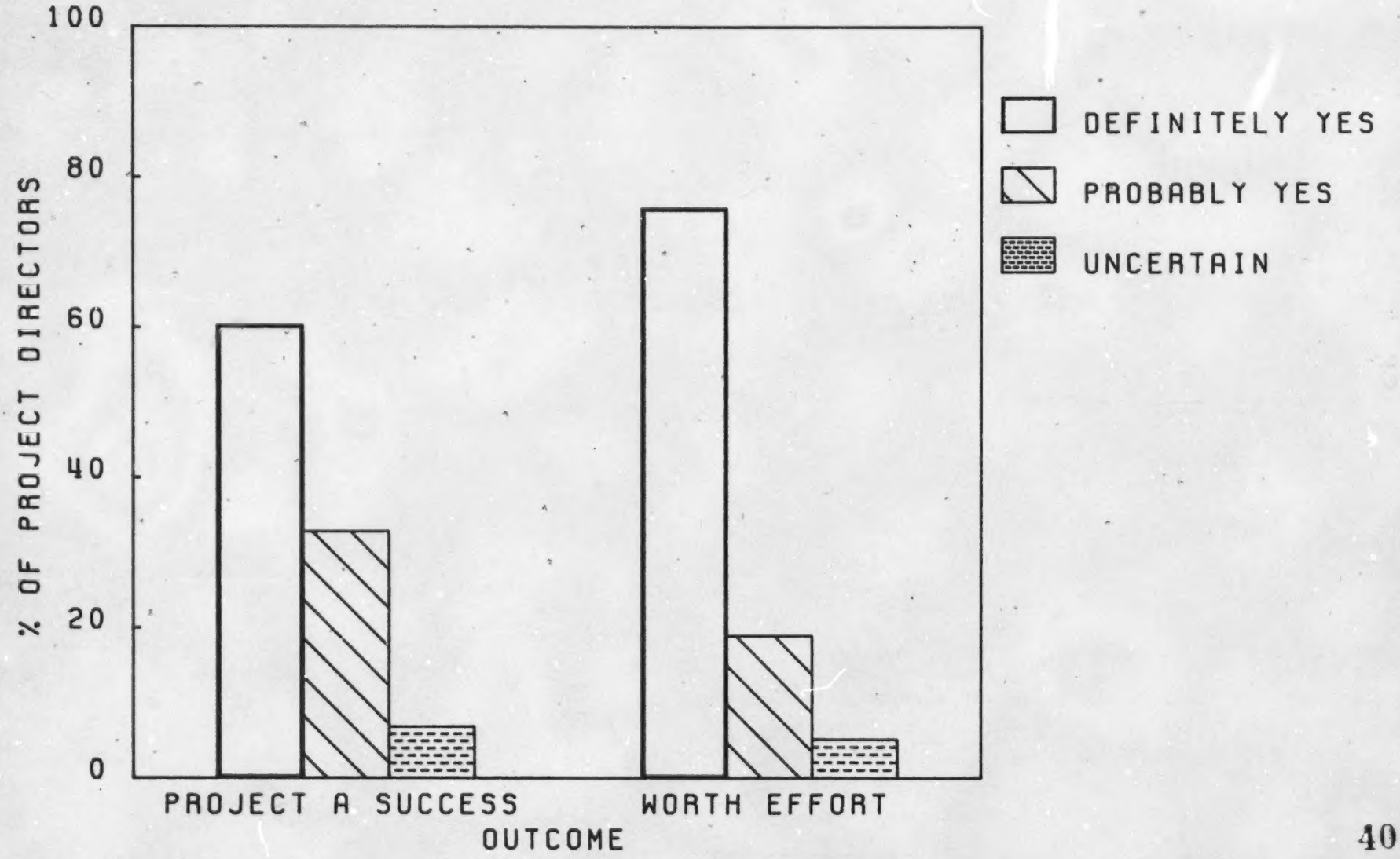


FIG. 11 - STUDENT BENEFITS REPORTED BY PROJECT DIRECTORS

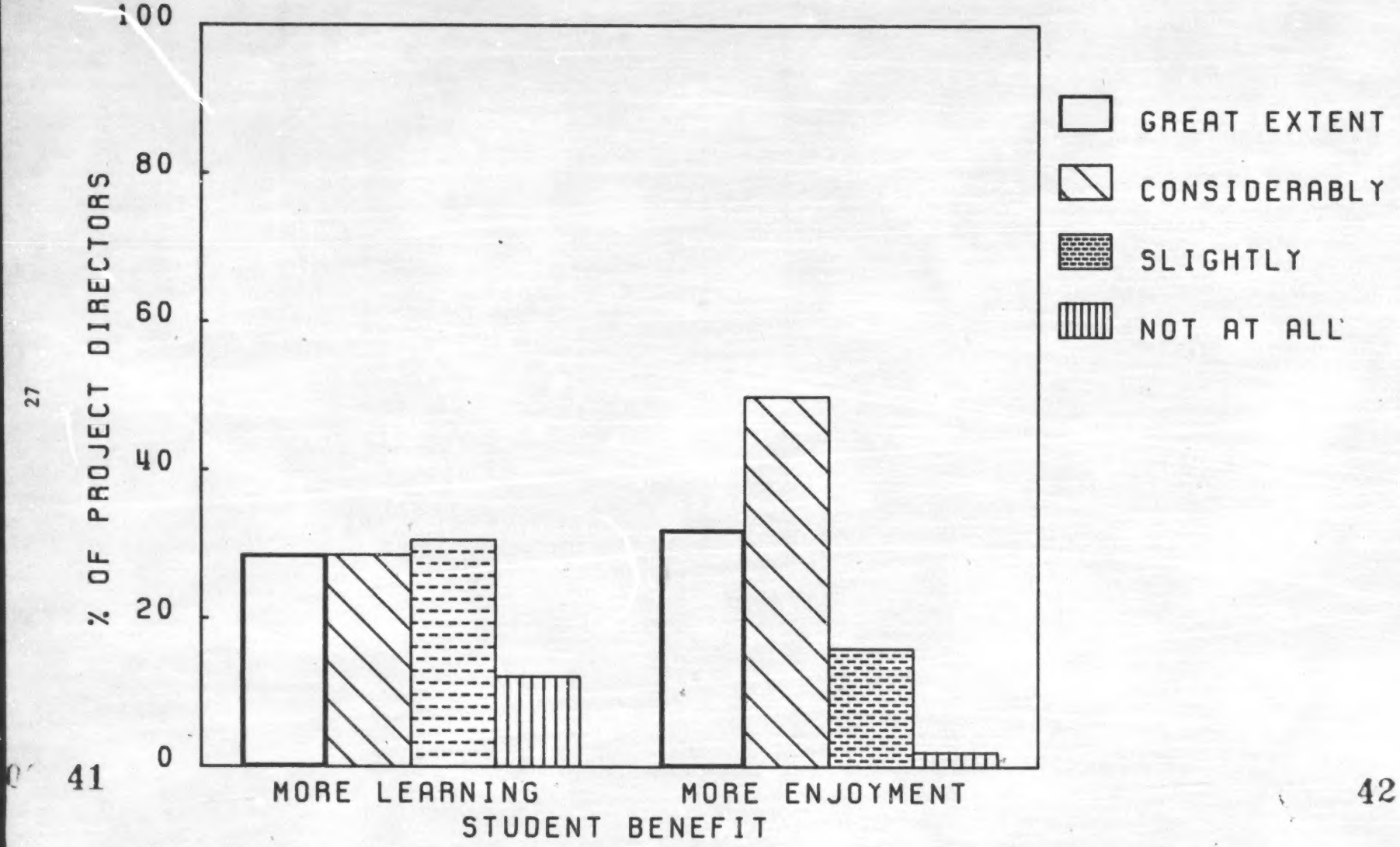
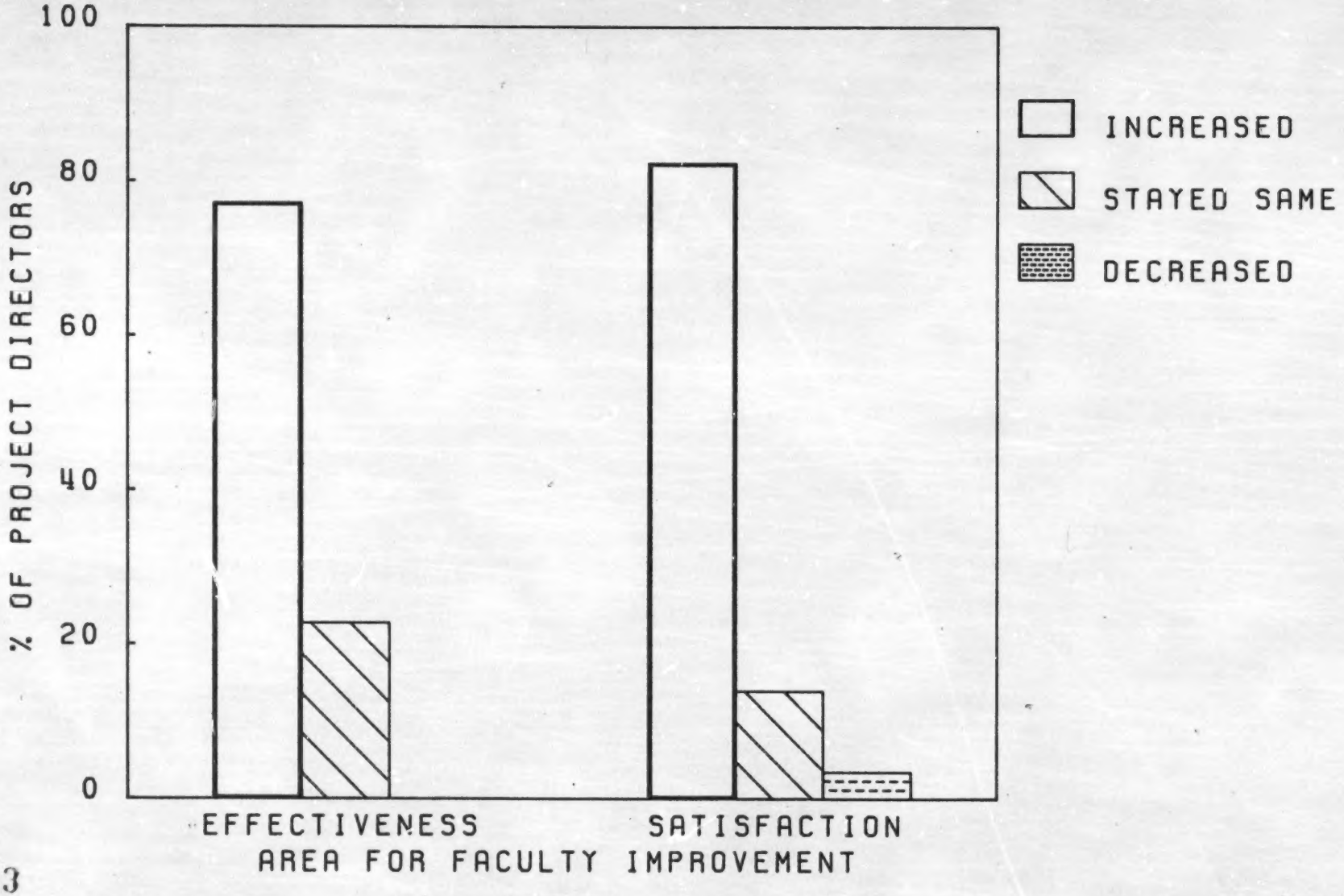


FIG. 12 - FACULTY BENEFITS REPORTED BY PROJECT DIRECTORS



Chapter 6

Conclusions

The following are the most important conclusions from our evaluation of the LOCI program:

1) This program is directed toward real needs that college teachers feel. Most college science teachers think that the content and methods of science courses at their institutions need revision; most rate the kind of support that LOCI can provide as highly valuable; and most report that this support is not available locally. There appears therefore to be a large group of college teachers that this program can serve.
2) The group of teachers who want to improve college teaching is diverse in membership. The group is not dominated by teachers in certain scientific fields, at certain ranks, or with certain kinds of undergraduate teaching responsibilities. Such factors do not influence perceptions of need to improve college teaching. Perceived needs are somewhat different at different types of institutions, however. They are highest at community colleges, lower at four-year colleges, and lowest at universities.
3) Individuals submitting proposals do not fully represent the population of eligible college teachers:
   a) Universities and four-year colleges submit more proposals than their undergraduate enrollments warrant; community colleges submit far fewer than their share of proposals.

b) Private institutions also submit more than their share of proposals.

c) The physical sciences, mathematics, computer sciences, and engineering submit a disproportionate share of the proposals; the biological sciences, social sciences, and psychology submit fewer proposals than expected.

4) Review of LOCI proposals by NSF review panels appears to be fair and even-handed. Proposals from all types of institutions and scientific fields have about the same chance of success--about one in four.

5) Most LOCI proposals do not commit the project directors to careful and controlled evaluation of project outcomes. Without well-planned evaluations, conclusions about results of projects will always be open to question. This is surely an area where better guidelines can be written for faculty members writing proposals and for reviewers reading them.

6) The success rate of LOCI project is not especially high. Perhaps six out of ten projects achieve their major goals. Among the factors that may contribute to the failure of individual projects are: emphasis on complex technology; emphasis on innovative rather than existing instructional approaches; and multi-course emphasis of the project. Factors that may contribute to project success are: career commitment by the project director to instructional research and development, and several years of teaching experience of the project director at his or her institution.

7) A major weakness of the program is its failure to obtain from project directors complete and detailed final reports on project outcomes. Few of the final reports submitted by project directors contain findings that can be used by LOCI program managers in monitoring program effectiveness. This seems to be a serious shortcoming of the LOCI program.

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